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APHIDS AS VECTORS OF LEAFROLL AMONG SPROUTING POTATO TUBERS

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F. C. STEWART AND HUGH GLASGOW

ABSTRACT

Announcement is made of the discovery of aphids (*Myzus persicæ* Sulz.) on sprouting potato tubers in New York. Altho this phenomenon is frequent in England and Ireland, it has been reported but once previously from America. Apparently the planting of infested tubers killed the aphids as none could be found on the aerial parts of the plants. The results of infection experiments show that aphids may spread leafroll freely among sprouting seed potatoes. Pronounced leafroll symptoms appeared within 35 days after planting. If one-half of an uncut healthy sprouting tuber is exposed for a few days to viruliferous aphids, and the other half closely covered to protect it from aphids, pieces of the former, when planted, will produce leafroll plants, while pieces of the latter will produce healthy plants. It was shown by experiment that fumigation with either tobacco powder or sodium cyanide will rid seed potatoes of aphids without injury to the tubers. The recommendation is made that seed potatoes which sprout before planting time be examined for aphids.

CIRCUMSTANCES ATTENDING THE ORIGINAL DISCOVERY

On June 13, 1928, the senior author purchased at a grocery store in Geneva 45 pounds of potatoes of a variety belonging to the Rural group. Since the potatoes were to be used for experimental purposes requiring smooth tubers of regular shape and of fairly uniform size, we were permitted to go to the room in which the potatoes were stored and make our own selection from a large pile. The tubers selected weighed between 3.5 and 4.5 ounces each. All had sprouted some, the length of the longest sprouts being from ¾ of an inch to 1 inch.

All sprouts were at once removed and the tubers thoroly washed. The tubers were then placed in a basket under a desk in the office of the senior author. Here they remained for two weeks in dim light and at a temperature of 65° to 75° F.

When next examined, on June 27, the tubers bore a second crop of sprouts ½ to ¾ of an inch long and were swarming with aphids. Almost every sprout of every tuber was covered with them, and hordes of aphids were crawling over the walls of the basket. It was plain that

the sprouts had been considerably injured by the aphids. The tips of many sprouts were dead and new sprouts were starting from other buds of the same eyes. On some tubers the growth of all sprouts had been arrested so completely that the tubers appeared to be just commencing to sprout.

The writers became interested because neither of them had previously observed aphids on sprouting potatoes and were unaware that the phenomenon occurs in America. Also, they realized the important relation which the phenomenon may have to the spread of leafroll, mosaic, and other virus diseases among seed potatoes.

IDENTIFICATION OF THE APHIDS

Some of the aphids were sent to Dr. Edith M. Patch, Entomologist of the Maine Agricultural Experiment Station, at Orono, Me. She reported that they belong to the species *Myzus persicæ* Sulz.

A RARE OCCURRENCE IN AMERICA

But one occurrence of aphids on sprouting potatoes has been previously recorded for America so far as known to the writers.[1] This appears strange because, according to Murphy (3, page 178; 4, page 14)[2] and Walton (9), it is frequent in England and Ireland. Perhaps

[1] This happened at Orono, Me., during the winter of 1918-1919. Schultz, Folsom, Hildebrandt, and Hawkins *(Jour. Agr. Res.* **17**:*261. 1919)* write as follows: "Some Green Mountain potatoes were used that had been grown in a rogued plot in northern Maine during the season of 1917 and had been kept for about a year in cold storage. One lot of 10 tubers was planted immediately and 2 of them, or 20 per cent, produced plants that were mottled when very young, evidently through field infection. Another lot of 30 tubers was stored in a cellar for a few weeks and then was found to have produced sprouts that had become lightly infested with green peach or spinach aphids. These aphids apparently had dispersed from a neighboring heavily infested lot of sprouted tubers that had come from a purely mosaic stock and that later produced mosaic plants. The number of insects on a tuber varied from 0 to 30, and there were few skins and but little honey-dew deposit present. The infested lot was fumigated and planted. Five tubers, or 17 per cent, produced plants that became mottled when very small, in 25 to 30 days after planting, evidently the result of field infection. In addition to these, 6 other tubers, or 20 per cent, produced both mottled and healthy shoots. This increase can be explained only by the infestation of the sprouts by the aphids from the diseased tubers. This explanation receives support from the observation that the mottled shoots of the six partly diseased tubers showed the symptoms later, averaging 44 days after planting, and that they usually came from eyes of the bud end and therefore were probably the first to become exposed to aphid attack."

This account first came to the attention of the writers while the present article was in press and too late for corrections to be made in the abstract published in Phytopathology, Vol. 21, No. 1. 1931.

[2] Refers to Literature Cited, page 21.

the green sprouting of seed potatoes before planting, a practise much more common in the British Islands than in America, may be responsible for the difference in aphid infestation in the two countries.

RELATION TO THE SPREAD OF VIRUS DISEASES

That infection of potatoes with leafroll and mosaic may take place thru their sprouts was first demonstrated by two American investigators, Schultz and Folsom (6, page 58), in 1921. They accomplished it by permitting aphids from the leaves of diseased plants to feed upon the sprouts of healthy tubers. The next advance was made by Murphy in Ireland. In 1922, he made the following announcement (2, page 283) "It has also been found that green flies [aphids] which sometimes occur on potatoes in sprouting boxes, are capable of carrying infection, in the case of leafroll at least, from the sprouts of a diseased tuber, if such be present, to the sprouts of neighboring healthy tubers." The details of Murphy's experiments were published in 1923 (4, page 14).

It is an important fact that the aphid involved in the outbreak here reported is the green peach aphid, or spinach aphid, *Myzus persicæ*, because this species is widely distributed and has a variety of host plants. It is often abundant on several different species of plants in New York, and other parts of the United States and Canada. Moreover, it has a bad reputation for spreading virus diseases. Smith (8, page 28) says: "Not only is it the chief, if not the sole, vector of potato leafroll in this country [England], but it is concerned, practically all over the world, with the dissemination of plant viruses of many kinds." Murphy and M'Kay (5, page 346), summarizing the results of their infection experiments in Ireland, say: "It is evident, therefore, that *Myzus persicæ* possesses a facility for transmitting leafroll not shared by the other aphides mentioned. Elze has come to the same conclusion * *."

ORIGIN OF THE INFESTATION

Altho undoubtedly some unusual condition or combination of conditions was responsible for this interesting outbreak, one wonders if the infestation of sprouting potato tubers by aphids may not occur in America more frequently than is indicated by the literature. The insects are small and may be easily overlooked unless present in large numbers. In this connection it should be noted that at the time of washing the tubers every one of them was handled by the senior author, in good light, and no aphids were noticed; yet it is practically certain that a considerable number of aphids were on the tubers at that time.

Otherwise, such an enormous number of aphids as were found on June 27 could not have been produced in two weeks. Also, there was no possible source of infestation in the room in which the potatoes were stored after washing.

Concerning the manner in which the potatoes first became infested with aphids, the most probable theory is that, either in the grower's storehouse or in the grocery storeroom, the potatoes came in contact with aphid-infested vegetables of some kind, for example, spinach, turnips, carrots, or lettuce. Probably a contributory factor was the warm weather of the season (June), which would be favorable for the rapid multiplication of the aphids.

A PLANTING EXPERIMENT

On June 28 the bud-end halves of 128 of the aphid-infested tubers were planted in rather heavy clay loam soil which was moist but not sticky. The seed pieces were laid, cut surface down, 15 inches apart in shallow trenches and covered immediately to a depth of 3 to 4 inches. Six of the planted seed-pieces were covered with cheesecloth cages to prevent the escape of any aphids which might find their way to the surface of the soil.

By July 16 most of the plants had emerged and ultimately there was a full stand. When the plants were 6 to 9 inches tall those outside the cages were carefully examined for aphids but none were found. Neither were any aphids found on the caged plants when they were examined a few days later. All of the 128 plants became affected with leafroll.

A SECOND OCCURRENCE

On March 20, 1930, a second occurrence of aphids on sprouting potato tubers was discovered by the junior author in a fruit and vegetable store in Geneva. About a bushel of small tubers were involved. They were culls from a lot of potatoes brought into the store the previous autumn. Most of the tubers bore sprouts which were abundantly infested with aphids. Of 206 tubers which were carefully examined with the aid of a hand lens 168 were found to be infested with living aphids; and the presence of cast skins on the sprouts of several of the remaining 38 tubers indicated that some of these, also, had been infested previously. On the sprouts of one small tuber there were 73 living aphids among which were several winged individuals. The species was *Myzus persicæ*, as before.

INFECTION EXPERIMENTS

CAN APHIDS SPREAD LEAFROLL AMONG SEED POTATOES?

The object of the following experiment was to determine if aphids are capable of spreading leafroll among seed potatoes. It is essentially like the experiment conducted by Murphy (4, page 14), the principal difference being that in this experiment the aphids were permitted to move, of their own accord, from the sprouts of tubers affected with leafroll, upon which they had been feeding, to the sprouts of surrounding healthy tubers; while in Murphy's experiment the aphids were forcibly transferred from the sprouts of leafroll tubers to the sprouts of healthy tubers.

In the latter part of March, 1930, nine tubers from plants known to have been affected with severe leafroll were removed from storage and mingled with some aphid-infested tubers in a warm room. Sprouts appearing on the leafroll tubers were promptly attacked by the aphids.

On April 4, 55 tubers from 55 different plants which had shown no symptoms of leafroll were removed from storage and set to sprout in a warm room in another building. These tubers were of the same variety as the leafroll tubers, *viz.*, Irish Cobbler.

By April 11 the healthy tubers bore short sprouts. Each was now divided lengthwise into halves. For identification purposes the tubers were numbered. For example, 4a and 4b were halves of the same tuber. Large, wide-mouthed glass jars were used for containers. As the 55 "a" pieces were packed into their jar the 9 aphid-infested leafroll tubers above mentioned were mingled with them. The 55 "b" halves placed in the other jar served as a check. The mouths of both jars were covered with cheesecloth. The jar of "a" halves was stored in the office of the junior author, and the jar of "b" halves in the office of the senior author in another building. Both jars stood in diffused light. Hence, the sprouts produced were short and green. The moisture conditions were such that short, stubby roots were formed on the sprouts. In the jar of "a" halves the aphids throve and multiplied and apparently moved about quite freely from the sprouts of one tuber to those of another.

On May 2, after exposure to the aphids for three weeks, each of the "a" tuber-halves was divided crosswise into two pieces which were at once planted in 6-inch pots in the greenhouse. At the same time and

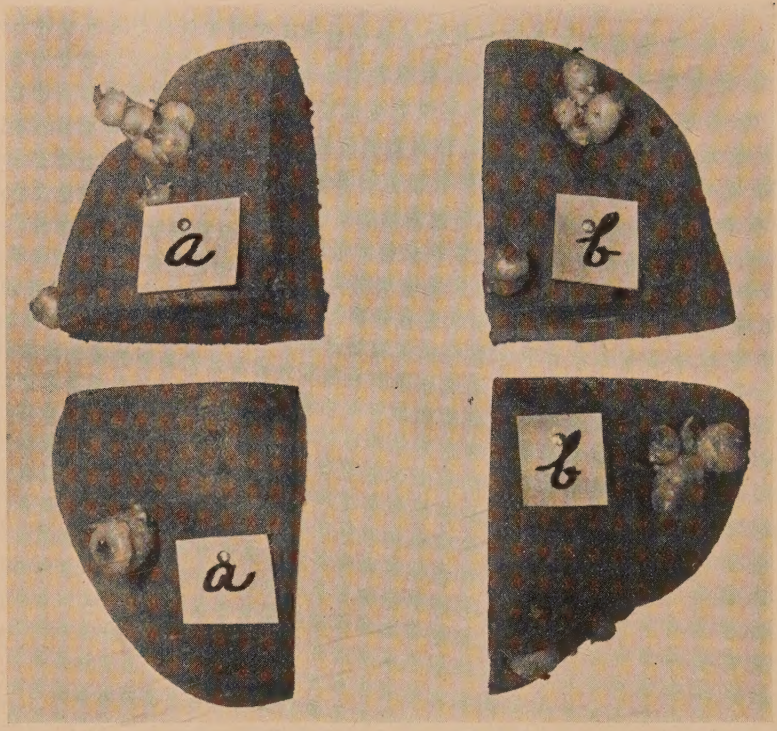

FIG. 1.—A SPROUTING POTATO TUBER CUT INTO FOUR PIECES.
To illustrate the manner of cutting the seed pieces in the first infection experiment. The upper pieces are from the bud end. (Natural size.)

in the same manner each of the "b" tuber halves was divided into two pieces and planted in the greenhouse. The manner of cutting the seed tubers is illustrated in Fig. 1. The four pots containing the four pieces (two "a" pieces and two "b" pieces) of each tuber were set together, side by side, on the greenhouse bench. In each tuber unit the two "b" pieces constitute the check. The total number of tuber units was 55 and the total number of plants produced 220.

During early May, before the emergence of the plants, there were a few days of clear warm weather when the temperature of the greenhouse ran high; but the cool, cloudy weather which followed from May 14 to 21 made conditions for the diagnosis of mosaic fairly good. From an examination made on May 23 it was determined that in eight of the tuber units all four plants were certainly affected with mosaic.

This shows that at least eight of the tubers, used in the experiment, altho produced by supposedly healthy plants, were actually affected with mosaic. Hence, if aphids were capable of spreading mosaic under the conditions of the experiment there was opportunity for them to do so. Unfortunately, observations to determine whether mosaic spread actually occurred were not made at the proper time and high temperatures which masked the mosaic made later diagnosis so uncertain that no reliable data on the spread of mosaic were obtained.

On June 4, 33 days after planting, the plants were carefully examined for leafroll. In 10 units one or both of the "b" plants showed positive symptoms of leafroll. This shows that 10 of the tubers used in the experiment, altho supposed to be healthy, were in reality affected with leafroll at the beginning of the experiment and, consequently, worthless for the purpose of the experiment.

In most of the 45 remaining units it was plain that the "a" plants were different from the "b" plants. Usually, they were distinctly lighter green in color. Often they were of smaller size. Many showed positive symptoms of leafroll, while "b" plants from the same tuber were perfectly normal. There was conclusive evidence that the aphids had spread leafroll widely among the "a" plants. However, the exact number of plants affected with leafroll could not be determined at this time. In several cases the leafroll symptoms were not clear. Units containing such plants were held a few days longer for further observation.

By June 11, 40 days after planting, the leafroll symptoms had become very plain and the contrast between "a" and "b" plants very marked in many units. (See Figs. 2 to 6.)

The final notes were made on June 19. From the completed record the following summary is made:

In eight tuber units all four plants were affected with mosaic. In two of these units all four plants were affected also with leafroll. In the other six units both "a" plants, but neither of the "b" plants, showed leafroll.

In 38 tuber units both "b" (check) plants were apparently normal, while one or both "a" plants showed positive symptoms of leafroll in all but one unit.

Of the 45 units in which there were no symptoms of leafroll in either of the "b" (check) plants, 44 had positive symptoms of leafroll in one

FIG. 2.—FOUR POTATO PLANTS FROM THE SAME SEED TUBER.

A tuber unit in the first infection experiment. Both of the "a" plants are affected with leafroll which resulted from aphids feeding upon sprouts of the seed pieces before planting. The "b" (check) plants are normal.

or both of the "a" plants; and of the 90 "a" plants in these 45 units 81 (or 90 per cent) showed positive symptoms of leafroll, 3 were suspected of having leafroll, 5 appeared normal, and 1 was abnormal from some undetermined cause.

MAY APHIDS INFECT SOME SPROUTS WITH LEAFROLL AND OTHER SPROUTS OF THE SAME TUBER REMAIN HEALTHY?

When an aphid feeds upon a potato sprout and infects it with leafroll, does the infection spread thruout the tuber and cause all plants produced by the tuber to become affected with leafroll, or is the infection confined to plants produced by sprouts of the particular eye upon which the aphid feeds? The latter is indicated by the observations of Schultz, *et al.* in Maine. (See footnote on page 4.) It was sought to obtain an answer to this question by means of a small experiment.

Six large tubers of the variety Irish Cobbler were used in the experiment. They were supposed to be free from leafroll and mosaic because the plants which produced them had shown no symptoms of either of these diseases. Each of the tubers came from a different plant. In this discussion they will be given the numbers of the plants which produced them; namely, tubers 150, 168, 193, 198, 202, and 203.

One-half of each tuber was closely covered to exclude aphids, and the remainder left exposed. The covering consisted of cotton which was glued to the skin of the tuber around the margin of the covered area, and cheesecloth was closely wrapped around the cotton to hold it in place. On three of the tubers the bud-end half was covered and on the other three the stem-end half.

On April 12, when their sprouts were ⅛ to ½ inch long, the six healthy tubers were placed in contact with three aphid-infested leafroll tubers in a warm room. Many of the aphids which had been feeding upon sprouts of the leafroll tubers now moved to sprouts on the exposed portions of the healthy tubers.

At the end of 42 days four seed pieces were cut from each of the six healthy tubers and planted in 6-inch pots in the greenhouse. Two of the pieces were taken from the exposed portion and the other two from the covered portion of each tuber. Sprouts on the covered portions of the tubers were searched thoroly for aphids, but none were found.

The plants were kept under observation for 37 days after planting. Evidence furnished by the plants from four of the tubers supports

FIG. 3.—POTATO PLANT AFFECTED WITH LEAFROLL.
The smaller "a" plant shown in Fig. 2. (About one-third natural size.)

the theory that leafroll virus introduced into potato sprouts by aphids does not pass thru the tuber to sprouts from other eyes. Seven of the eight plants from the exposed portions of these tubers showed positive symptoms of leafroll, while none of the eight plants from covered portions of the same tubers showed any sign of leafroll.

On the other hand, all four plants of one tuber (No. 202) were suspected of being affected with leafroll, altho the symptoms were not plain. While it is not impossible that Tuber No. 202 was affected with leafroll at the beginning of the experiment, it is improbable be-

FIG. 4.—A NORMAL POTATO PLANT.
One of the "b" plants shown in Fig. 2. (About one-third natural size.)

cause another tuber of the same plant used in another experiment produced a normal plant.

Also, one plant from the covered portion of Tuber No. 203 was suspected of having leafroll. Both plants from the exposed portion

FIG. 5.—LEAF OF A POTATO PLANT AFFECTED WITH LEAFROLL.
From the plant shown in Fig. 3. (Natural size.)

of this tuber were certainly affected with leafroll. Another interesting feature of the plants from No. 203 is the fact that all four were plainly affected with mosaic which, apparently, was not transmitted by the aphids to any of the plants from the other five tubers. That mosaic was in No. 203 at the beginning of the experiment is shown by the fact that another tuber of the same plant used in another

FIG. 6.—LEAF OF A NORMAL POTATO PLANT.
From the plant shown in Fig. 4. (Natural size.)

experiment produced a plant affected with mosaic, but this plant was not affected with leafroll.

Table 1 presents the results of the experiment in another form.

TABLE 1.—HEALTH OF PLANTS FROM COVERED AND EXPOSED PORTIONS OF THE SAME TUBER IN AN EXPERIMENT TO DETERMINE IF LEAFROLL INFECTION VIA THE SPROUTS SPREADS FROM EYE TO EYE THRU THE SEED TUBER.

TUBER NO.	SPROUTS EXPOSED TO LEAFROLL INFECTION BY APHIDS		SPROUTS COVERED TO PROTECT THEM FROM APHIDS	
	Number of Plants	Health of Plants	Number of Plants	Health of Plants
150	2	Both plainly affected with leafroll	2	Both normal
168	2	One plainly affected with leafroll, the other suspected of having leafroll	2	Both normal
193	2	Both plainly affected with leafroll	2	Both normal
198	2	Both plainly affected with leafroll	2	Both normal
202	2	Both suspected of having leafroll	2	Both suspected of having leafroll
203*	2	Both plainly affected with leafroll and also with mosaic	2	Both plainly affected with mosaic; one suspected of having also leafroll

*Probably affected with mosaic at the beginning of the experiment.

EXAMINATION OF SEED POTATOES FOR APHIDS

The observations here reported lead, naturally, to the recommendation that seed potatoes be examined for the presence of aphids. This is particularly important for the growers of seed potatoes and investigators of the virus diseases of potatoes. Probably little attention need be given tubers which have just begun to sprout at time of planting; but tubers with long sprouts should be carefully examined. Special attention should be given to seed potatoes which have been stored near other vegetables; also, to those which have been sprouted in greenhouses before planting. *Myzus persicæ* is common in greenhouses. Because of their small size, sluggish movements, and color, which often resembles that of the sprouts, the aphids are difficult to detect. A pocket magnifier is very useful in searching for them.

DOES PLANTING KILL THE APHIDS?

When aphid-infested potatoes are planted there is the possibility that some of the insects may find their way to the surface of the soil and start an early infestation of the foliage. Walton (9) states that planting kills the aphids, altho, in one instance, he found a single aphid on a plant grown from an infested tuber. On the other hand, Murphy (4, page 14) has observed that "some of the developing sprouts carry aphids with them above the surface of the ground." In another paper (3, page 181), he reports having observed that aphids on sprouts may give rise to the first seasonal infestation of the foliage with aphids. As already stated, in the experiment made by the writers no aphids were found above ground.

METHODS OF CONTROL

Any method of treatment to be successful in preventing aphids from spreading virus diseases among seed potatoes must obviously be applied early before the aphids have become numerous. Hence the importance of detecting the presence of the aphids as early as possible.

Atanasoff (1, page 523, footnote) recommends exposure of the tubers for several hours to the fumes of nicotine extract, 250 cc for each 40 cubic meters of space.

Murphy (4, page 15) reports commercial greenhouse fumigators not entirely satisfactory, but exposure for three days to the fumes of tetrachlorethane (1 pound to 15 hundredweight of potatoes in 1,700 cubic feet of space, tightly enclosed) gave perfect control. Walton (9), also, found tetrachlorethane "quite effective" even with an exposure of only one hour at a temperature of 50° to 60° F. Two per cent nicotine applied in dust form likewise gave good results.

Myzus persicæ is an omnivorous feeder, including as it does in its list of hosts practically all the common vegetable crops as well as many other plants.

When potatoes intended for seed are stored in close proximity to vegetables, such as spinach, turnips, celery, or similar crops that may harbor the insect, there is always a possibility of the potatoes becoming infested. In case such a source of infestation is present, or if the spread of aphids in storage is feared, it may be helpful as a precautionary measure to apply liberal amounts of finely ground tobacco dust to the tubers as they are being placed in storage.

Fumigation of infested seed potatoes in storage with hydrocyanic acid gas, using approximately ½ ounce of sodium cyanide per 1,000 cubic feet of space, or with a high nicotine tobacco powder, using at least 1 ounce per 1,000 cubic feet of space, has been found to destroy the insects on the sprouts in two or three hours if the storage room is reasonably tight.

FUMIGATION EXPERIMENTS

Some tubers were removed from storage on March 21 and set to sprout in a warm room. At the same time they were permitted to become infested with aphids *(Myzus persicæ)* by mingling with them some of the aphid-infested tubers bought at a Geneva vegetable store (page 6). By April 23 the tubers bore robust sprouts which were 10 to 30 mm long and abundantly infested with aphids. They were then divided into eight lots of 18 tubers each and fumigated in different ways as shown in Table 2. The fumigation chamber used had a capacity of 3.47 cubic feet. The temperature ranged between 69° and 72° F.

After fumigation the tubers of six of the lots (III to VIII) were planted in 6-inch pots in a greenhouse.

In a few days all broke ground with normally robust sprouts. There was no indication that any injury had been caused by any of the treatments. Subsequently, 58 per cent of the plants showed positive symptoms of leafroll and 35.5 per cent were affected with a degeneration disease not positively identified. It may have been either rugose mosaic (masked) or streak as understood by Schultz and Folsom (7).[3] Several of the plants showed symptoms of both dis-

[3] The affected plants were much dwarfed. Their leaves were of normal color but small, somewhat rugose, and covered with numerous dead brown spots which were either circular or angular and often with radiating extensions along the veins. Sometimes there were short dark streaks on the petioles and, occasionally, also on the stems. Many of the severely affected leaves soon died. Some fell to the ground while others withered without falling. Some were merely browned around the margin and continued to function. In several instances one stem was much dwarfed by the disease while another stem from the same tuber was of normal height and apparently healthy. The affected plants were distributed as follows: In lot III, 7; in lot IV, 7; in lot V, 4; in lot VI, 9; in lot VII, 6; and in lot VIII, 5.

TABLE 2.—FUMIGATION EXPERIMENTS WITH APHIDS ON SPROUTING POTATO TUBERS.

LOT NO.	FUMIGATED WITH	NUMBER OF APHIDS PRESENT	EFFECT ON APHIDS		EFFECT ON SPROUTS
			Immediate	After 48 Hours	
I	Sodium cyanide, ¼ oz. to 1,000 cu. ft., 2 hours	490	Some still living	All dead	Trace of browning on tips
II	Sodium cyanide, ½ oz. to 1,000 cu. ft., 2 hours	632	All dead	All dead	Trace of browning on tips
III	Sodium cyanide, 1 oz. to 1,000 cu. ft., 2 hours	842	All dead	All dead	A few tips slightly browned
IV	Sodium cyanide, 1 oz. to 1,000 cu. ft., 12 hours	758	All dead	All dead	Tips of one-half of the sprouts slightly browned
V	Sodium cyanide, 10 oz. to 1,000 cu. ft., 2 hours	520	All dead	All dead	Tips of nearly all sprouts browned—some slightly, some severely
VI	Tobacco powder,* 1 oz. to 2,500 cu. ft., 2 hours	792	Majority able to move legs and antennæ	Many still living; 11 normal†	Tips show only traces of browning
VII	Tobacco powder,* 1 oz. to 1,000 cu. ft., 2 hours	803	Majority still able to move legs and antennæ	Many still able to move; none normal‡	Tips show only traces of browning
VIII	Tobacco powder,* 10 oz. to 1,000 cu. ft., 2 hours	565	Some still able to move slightly	All dead	Tips show only traces of browning

* "Nico-fume" tobacco powder; 12.5 per cent nicotine.
†At end of five days three individuals were feeding normally and one of them giving birth to young.
‡All dead after five days.

eases. The presence of leafroll is readily explained. A small preliminary greenhouse test of tubers from the same bin indicated that the stock contained about 20 per cent of leafroll but no streak or similar disease. The increase to 58 per cent of leafroll among the plants from the fumigated tubers may be ascribed to the aphids, but it is doubtful if the aphids can be held responsible for the outbreak of streak. As above stated, there appears to have been no streak in the stock from

which the fumigated tubers came. Also, there was no streak or similar disease in the grocery stock which furnished the aphids used in the experiment. This is shown by a greenhouse test of 32 tubers. Moreover, there was no streak among 110 plants of Irish Cobbler used in the infection experiments and grown in the same greenhouse at the same time from tubers whose sprouts had been infested with aphids from the same source for three weeks previous to planting. (See infection experiments, pages 7 to 11.) Whatever the source of the streak infection there is no reason for believing that it resulted from the fumigation of the seed tubers.

SUMMARY

In June, 1928, and again in March, 1930, sprouting potato tubers purchased at grocery stores in Geneva, N. Y., were found infested with large numbers of the green spinach aphid, *Myzus persicæ*.

Altho *M. persicæ* is common and often abundant in the United States and Canada on the foliage of several different kinds of plants, including the potato, and altho it is known to occur frequently on sprouting potato tubers in England and Ireland, it has been previously reported on sprouting potatoes in America but once.

The probability that sprouting seed potatoes, also, are sometimes infested with the insect, coupled with the fact that *M. persicæ* is an important agent in the spread of virus diseases among potatoes, gives the discovery considerable importance.

An experiment made at this Station corroborates a similar experiment made by Murphy in Ireland in showing that the aphids are capable of spreading leafroll among sprouting seed potatoes. In our experiment the remarkably high percentage of 90 per cent of positive leafroll infection was obtained when aphids which had previously fed upon the sprouts of tubers affected with leafroll were permitted to feed upon the sprouts of tubers free from leafroll.

In another experiment it was shown how leafroll and healthy plants may be obtained from different pieces of the same seed tuber by permitting viruliferous aphids to feed upon some sprouts of an uncut healthy tuber and excluding them from others. This means that leafroll infection which enters by way of the sprouts does not pass from one eye to another thru the seed tuber. However, there were indications that exceptions to this rule may sometimes occur.

The results of fumigation experiments indicate that aphids on seed potatoes may be killed without injury to the tubers by fumigating them in a tight room for 2 or 3 hours with either a high nicotine tobacco powder or sodium cyanide, using at least 1 ounce of the former or ½ ounce of the latter for each 1,000 cubic feet of space.

It is recommended that seed potatoes which have sprouted before planting be examined for aphids. If aphids are present it is important to discover them and get rid of them early.

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